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Notes on Potentilla.—V.

By P. A. Rydberg.

(Plates 276, 277.)

The *Subviscosae* is a small group of low plants with many more or less spreading branches from the caudex, with a silky or hirsute pubescence, often intermixed with almost sessile glands, but not at all tomentose; with digitate leaves of 5–7 leaflets, and in fruit, with incurved sepals which enclose the large, but comparatively few achenes. The petals are more or less contracted at the base, *i. e.*, semi-unguiculate, although indistinctly so in *P. Wheeleri.*

Potentilla Wheeleri Wats. Proc. Am. Acad. 11: 148. 1876.

The pubescence is quite densely silky, and the typical form is apparently without glands. The leaflets are obovate and crenate at the rounded summit, 1–1.5 cm. long. The petals are obcordate, slightly contracted at the base, and a little exceed the calyx. It has been collected in southern California, Arizona and northern Mexico. A form connecting it with the next may be regarded as a variety or perhaps as a distinct species. It may be known for the present as

Potentilla Wheeleri viscidula n. v.

Subcaespitose, rather hirsute with spreading hairs, somewhat glandular-granuliferous on the calyx, pedicel, etc.; leaflets shorter and broader, generally less than 1 cm. long.

The following specimens have been seen:

Arizona: C. G. Pringle, 1881; J. G. Lemmon, no. 158. 1881.

California: W. G. Wright, 1879; Coville & Funston, no. 1672. 1891.

Pringle labelled his specimens *Potentilla subviscosa* Greene (near *P. Wheeleri* Wats.). I think, however, that it should be referred to *P. Wheeleri* rather than to *P. subviscosa*, as it does not have the dissected leaves and the subunguiculate petals of *P. subviscosa*.

POTENTILLA SUBVISCOSA Greene, Bull. Torr. Bot. Club, **8**: 97. 1881.

Differs from *P. Wheeleri* in the leaflets, which are deeply cleft into oblong divisions, and the middle one often 3-divided to near the midrib, in the petals which are more or less plainly unguiculate and about one-half longer than the sepals, in the more hirsute pubescence which is intermixed with numerous glands. It resembles closely the figure of *P. Dombeyi* in Nestler's Monograph, but neither Nestler nor Lehmann mention anything concerning the glands or the unguiculate petals. *P. Dombeyi* was described from specimens from Chili, but has been reported from Mexico. I have not seen any specimens and doubt its existence there. *P. subviscosa* grows in Arizona and New Mexico.

POTENTILLA RAMULOSA n. sp.

Stems several from the thick perennial root, about 1 dm. high, scarcely exceeding the basal leaves, more or less hirsute, and branched. Stipules lanceolate, the lower scarious and brown, the upper herbaceous; basal leaves on hirsute petioles 5–8 cm. long, finely pubescent, in age shining; leaflets 5–7, obovate, coarsely and generally doubly toothed with somewhat divergent teeth, prominently veined beneath, the larger 5–7 cm. long. Flowers slender-pediceled in an open cyme; calyx and pedicels hirsute and with numerous sessile glands; bracts oblong, a little shorter than the oblong-ovate sepals; both distinctly veined, in fruit incurved and inclosing the rather few large achenes; petals obcordate, deeply emarginate and evidently contracted in a short claw; stamens 15–20; pistils rather few; achenes striate. (Plate 276.)

P. ramulosa resembles *P. subviscosa*, but is a much larger plant. The leaves, by their size, pubescence and form, remind one somewhat of *P. Nuttallii* and *P. Blaskeana*. The leaflets reach a length of even 7 cm. The general habit, form of calyx and corolla, etc., are those of *P. subviscosa*, but the achenes are striate. The following specimens have been examined:

Arizona: J. G. Lemmon, no. 399, 1881; H. H. Rusby, 1883.

The *Concinnae* have the same relationship to the *Niveae* as the *Aureae* have to the *Frigidae*, *i. e.*, they are *Niveae* with more than three leaflets. From the *Subviscosae* they differ by the tomentum on at least the lower surface of the leaves, and by their petals, which are not at all unguiculate.

POTENTILLA CONCINNA Richardson, Frank. Journ. 736. 1823.

P. concinna resembles *P. nivea* in many respects, especially the variety *quinquefolia*, but is always more or less prostrate, and has broader petals and sepals. It is very variable as to the shape of the leaves. In the typical form the leaflets are obovate or cuneate and crenate, and slightly tomentose also on the upper surface. It ranges from Colorado to Utah and Saskatchewan.

Potentilla concinna humistrata Rydberg, Cont. U. S. Nat. Herb. 3: 497 (*P. concinna humifusa* Lehm. Rev. Pot. 112. *P. humifusa* Nutt. Gen. 1: 310.) is a less spreading form with leaves that are green on the upper surface, but the two forms grade into each other in so many ways that it is useless to try to draw a line between them.

P. CONCINNA DIVISA n. v.

P. nivea dissecta S. Wats. Proc. Am. Acad. 7: 556, at least in part. 1873. Not *P. dissecta* Pursh, 1814.

Leaflets pinnately divided. In a few cases the leaves are also pinnate rather than palmate.

Dr. Watson included the three first specimens cited below in his *P. nivea dissecta*, but in every respect they are much nearer *P. concinna* than *P. nivea*, the sepals, petals and general habit being exactly that of the former.

Rocky Mountains: Douglas.

Montana: Howard.

South Dakota: Jenney. 1875; W. H. Forwood, 1887; P. A. Rydberg, nos. 672 and 673. 1892.

Assiniboia: John Macoun, no. 10,468, 1895.

POTENTILLA BICRENATA n. sp.

Low and simple from an erect scaly rootstock; stem erect, 5–7 cm. high, about equalling the leaves, 1–3-flowered, nearly

leafless; basal leaves on petioles 3–6 cm. long, digitately 5-foliolate, silky and greenish above, white-tomentose beneath; leaflets ½–2 cm. long, oblong-cuneate, margins entire, except at the very apex, where there are 2 (seldom 4) notches making the leaflet 3- (seldom 5-) toothed at the apex, the middle tooth generally the smallest; flowers about 1 cm. in diameter; calyx silky; bractlets and sepals ovate or lance-ovate, the former smaller; petals obovate, merely truncate.

It much resembles the preceding, but is more delicate, not at all spreading, has a subscapiform stem and smaller flowers, but the most striking difference is the form of the leaflets.

New Mexico: C. D. Walcott, no. 66, 1883 (Type).

Colorado: E. L. Greene, 1875.

The *Multijugae* is a group of Potentillas in many respects reminding us of the *Multifidae*. The leaves in both are pinnate with several leaflets, but the pinnae in the present group are generally much more numerous; the pubescence is hirsute, strigose or silky, always without any indication of tomentum, and the style is always long and filiform. To this group belong *P. Richardii* Lehm., from Mexico, differing from *P. Plattensis* mainly in the spreading pubescence, and the following North American species:

POTENTILLA PLATTENSIS Nutt.; Torr. & Gray, Fl. N. Am. 1: 439. 1840.

The type specimens of Nuttall have light green leaves with 4–8 pairs of oblong-cuneate leaflets, dissected into broadly oblong obtuse segments ½ cm. long, and a stem that is more or less ascending. In the more common form, however, the segments are often ¾ cm. long, nearly linear and often acute, the stem more or less spreading and the flower-clusters very irregular. It may be a good variety.

All forms of *P. Plattensis* are characterized by the stipules, which are unusually large for the size of the plant. Its range is from Colorado and Utah to the Saskatchewan, but it belongs to the valleys of the high plains rather than to the alpine regions.

POTENTILLA PINNATISECTA (Wats.) Aven Nelson, Bull. Wy. Exp. St. 28: 104. 1896.

P. diversifolia pinnatisecta Wats. King's Rep. 5: 87 (in part), 1871.

P. ovina James Macoun, Can. Rec. Sci.

The specimens from which *P. diversifolia pinnatisecta* were described, viz: Watson's nos. 331 and 332 of the King Expedition illustrate, I think, not less than three different species. In the Gray Herbarium, no. 331 is represented as it seems by a typical *P. Plattensis*. This is doubtless the reason why Watson afterwards transferred the var. *pinnatisecta* to that species. No. 332, which Watson, in King's Report, characterizes as an alpine more hairy form, is there represented by a specimen of what James Macoun describes as *P. ovina*. This may be regarded as the typical *P pinnatisecta*, as the other forms of the collection are already named In the Columbia Herbarium, no. 331 is represented by an unusually large form of *P. pinnatisecta* (*P. ovina* Macoun) and no. 332 by a depauperate specimen of *P. Breweri expansa* Wats.

The main differences between *P. Plattensis* and *P. pinnatisecta* are well pointed out by Prof. Nelson, *l. c.*, only that his characterizing of *P. Plattensis* refers rather to the most common, more prostrate form with narrow segments, mentioned above, and that his specimens representing *P. pinnatisecta* are unusually large, less hairy and with longer segments than usual. The typical form is subcaespitose, seldom over 1 dm. high, with nearly leafless flowering stems, smaller stipules than in *P. Plattensis*, and a densely hoary pubescence, especially when young. It ranges from Colorado and Utah to British America, and is a strictly alpine plant.

Potentilla millefolia n. sp.

Low, prostrate or spreading; stems numerous from the caudex, about 1 dm. long, few-leaved, only a little exceeding the basal leaves, appressed-strigose, often sparingly so. Lower stipules lanceolate and scarious and brown, the upper ovate-lanceolate, acute or acuminate, green, often 2–3 cleft. Basal leaves pinnate, of many pairs, sparingly strigose-ciliate, nearly as long as the stems; stem-leaves much reduced. Leaflets divided nearly to the base into linear subulate divisions, which therefore look as if verticillate. Pedicels slender, 1–2 cm. long, in fruit abruptly reflexed below the strigose-hirsute calyx. Bractlets and sepals lanceolate, acute, the former slightly smaller. Corolla 12–18 mm. in diameter. Petals obcordate, deeply notched, longer than the sepals. Stamens about 20. Achene smooth, with a slender filiform nearly terminal style. (Plate 277, figs. 1–5.)

P. millefolia most resembles *P. Plattensis*, but differs in the long and very narrow segments of the leaves, the reflexed fruiting calyx and the longer sepals. The following specimens have been examined:

California: J. G. Lemmon, 1873, 1874, and no. 86, 1875 (Type); E. L. Greene, no. 750, 1876; J. W. Congdon, no. 277, 1880.

POTENTILLA MULTIJUGA Lehm. Rev. Pot. 29, 1856.

This species has been lost for about 40 years. As in the collections of this country there were no specimens of a *Potentilla* whose leaves resembled those of Lehmann's plate, and as those of the latter resembled the leaves of *Horkelia cuneata*, most botanists have cited *P. multijuga* as a synonym of that species, and even Professor Greene, in Flora Fransiscana, has adopted the name. It is not very likely that such an acute observer and eminent botanist as Dr. Lehmann would have figured a *Horkelia* with true *Potentilla* flowers. In two collections, viz., those of the National Herbarium and the herbarium of Harvard University, I have found a *Potentilla* that answers Lehmann's description and plate, except that the plant is more rank and the leaflets are larger, more irregular in form and position.

P. multijuga resembles much *P. Plattensis*, but the leaflets are more numerous, 8–13 pairs, obovate-cuneate and toothed only toward the apex, and the sepals broader ovate and abruptly contracted at the apex. The leaflets in Lehmann's figure are about 2 cm. long; some in the latter specimens are nearly ½ decimeter. Lehmann's figure illustrates an undeveloped specimen about 2½ dm. high. Some of the better developed specimens are ¾ m. high, with leaves 3 dm. long.

POTENTILLA DRUMMONDII Lehm. Nov. Stirp. Pug. 2: 9. 1830.

Watson included this in *P. dissecta*. As he had only comparatively poor specimens, with few, more approximate leaflets, it was not strange that he did so, especially with his tendency of uniting forms somewhat related. Had he had such specimens as those collected by Suksdorf, or the one from which Lehmann's figure was drawn, I doubt if he had done it. Such well-developed specimens have pinnate leaves of 3–5 rather distant pairs of leaflets,

very large stipules resembling those of *P. Plattensis* and a large calyx which is strongly hirsute. From *P. Plattensis* and the other species of the group it differs in the stoutness of the plant, which is 3–6 dm. high and by the fewer (2–5 pairs) and larger leaflets, which are from 3–6 cm. long, and the acute teeth. It is a rare species. The only specimens seen are the following:

Washington: W. N. Suksdorf, no. 539. 1875.
Oregon: Elihu Hall, no. 135. 1871.
California: J. G. Lemmon, no. 1200. 1875.
British Columbia: John Macoun, no. 32. 1890.
Rocky Mountains of British America: E. Bourgeau, 1858.

Phyllotaxy as a Guide to Plant Analysis.

By A. L. Benedict.

There are few discrepancies in teaching more striking than the contrast between the elaborate discussion of leaf-arrangement in nearly all text-books and courses on Organography and the neglect of the subject in practical analysis.

Omitting the leaves of cryptogams and the coniferae, two methods of arrangement are found, the verticillate or whorled and the spiral, alternate or scattered. The words verticillate and whorled are really the same, if we seek their root. The term *scattered* is highly objectionable, since it suggests that the leaves occur haphazard, but nowhere in botany is a more exact mathematical system followed than in the putting forth of leaves. The term *alternate* should, from its meaning, be limited to the simplest variety of spiral phillotaxy, in which the leaves occur, first on one side and then on the other, of the stem.

If we conceive the outer layer of the stem to be made up of a number of columns of cells, we have a simple and lucid explanation of the decussation of adjacent whorls and of the spiral line in which leaves are otherwise thrown out. The development of a leaf involves a tremendous expenditure of vitality and it is easy to understand why one whorl of leaves should issue from the columns which have rested during the formation of the preceding whorl,

and why, in the other form of phyllotaxy, the effort should take place in relays till the first column is again reached.

Considering the number of primitive leaves in the seed, it is obvious that we must regard the normal phyllotaxy of exogens as originally whorled and with two leaves in a whorl, while the leaves of endogens have, at first, a spiral arrangement. This conception, however, must not be taken as a practical guide for the study of mature plants, as it would prove misleading in a large proportion of cases. It is also obvious that the flower is, in nearly every instance, a compact series of whorls, whatever the arrangement of the foliage leaves.

The whorled phyllotaxy is very simply subdivided, according to the number of leaves in a circle. This number, omitting the primitive leaves and the flowers, is the same for every whorl of any individual, although it may differ in individuals of the same species. For example, I have found growing within a few feet of one anotl :r, *Eupatoria* with five, six and seven leaves, respectively, in a whorl; yet all were of the same species (*E. purpureum*, I believe) and, from their proximity, may very probably have grown from seeds of the same plant. Like almost every botanical feature not connected with the flower, phyllotaxy is a very unreliable guide to generic and family grouping. Thus, all the mints have opposite leaves, but the closely-allied family of figworts includes examples of both general kinds of phyllotaxy; none of the genera of the composite family embrace species illustrating both kinds, but the genus *Cornus* includes both alternate-leaved and opposite-leaved dog-woods.

My notes on phyllotaxy as a guide to analysis, relate almost without exception to the trees of North-eastern America, and are supplementary to the excellent table of Charles S. Newhall. All subsequent statements, must, therefore, be understood with this qualification.

First of all, is to be noted a great preponderance of the spiral phyllotaxy, there being only seven genera represented, with opposite leaves—*Acer, Negundo, Fraxinus, AEsculus, Viburnum, Chionanthus*, and the single species, *florida*, of *Cornus*. *Catalpa* is the only instance of a tree with more than two leaves in a whorl, having usually three (but sometimes only two.—Wood).

Although not strictly belonging in a discussion of phyllotaxy, the arrangement of leaflets is an interesting and valuable guide to the study of our native trees. The palmately compound leaf is represented only by the genus *AEsculus*, whose leaves are also opposite. Of the trees with pinnately compound leaves, only two genera, *Fraxinus* and *Negundo*, belong to the opposite-leaved group, and of all the trees with compound leaves there are but two with abruptly pinnate leaves, namely, *Gleditschia* and *Gymnocladus*, in which the compounding is also carried to the second or third degree.

The spiral phyllotaxy is subdivided according to the number of leaves in a series, which may be considered as a whorl lengthened out by the growth of the stem between the times at which leaves were put forth. The beginnings of the several series—or, of course, any corresponding leaves of different series—are in the same perpendicular column. A series of any particular number of leaves is also included in a certain number of spiral turns about the stem. Thus, the simplest series has its leaves arranged 1–2, 1–2, each leaf being half a circumference from the next and the series of two leaves being completed in one turn. The next series runs 1–2–3, 1–2–3, each leaf being a third of a circumference from its neighbor, so that this series is also completed in one spiral turn. The next series contains five leaves, but each is $\frac{2}{5}$ instead of $\frac{1}{5}$ of a circumference from the next leaf above or below, so that the series requires two turns about the stem before we reach a leaf directly above no. 1. It will be noticed that nature has apparently formed this third series by adding together the number of turns and the number of leaves of the two preceding series, just as little children would add the fractions $\frac{1}{2}$ and $\frac{1}{3}$, numerator to numerator and denominator to denominator, and get the result $\frac{2}{5}$. The next series, characterized by eight leaves and three spiral turns, seems, likewise, to have been formed by adding the one-turn and three-leaf series to the two-turn and five-leaf series. A series higher still has $2 + 3$ turns and $5 + 8$ leaves. Beyond this, we may still imagine nature continuing to add numerator to numerator and denominator to denominator, but the leaves become so densely crowded, that we cannot bring them into order and, hence, we term the arrangement a fascicle, or *bunch* to translate

literally. It should be remembered that Nature never adds any but consecutive series together, and this is the best possible support of our theory, that one series really is joined with the next one, the distance between the adjacent leaves being averaged so that each successive fraction represents the numerator to numerator and denominator to denominator addition of the two next simpler series.

The elms, hornbeam, hop-hornbeam and beeches form a group by themselves. All have simple leaves, of about the same general outline, ovate or quite broadly elliptical, with acuminate apices, rounded bases and serrated margins, those of the elms and the hornbeam being bi-serrate, and, most remarkable of all, every one of this group has its leaves arranged on the ½-spiral plan, with the additional peculiarity that the leaves of a branch lie in the same plane with the stem, as if already pressed. The basswood, buttonwood and mulberries have the same flattened spray, but the similarity of the individual leaves is not marked. The mulberries are like the sassafras in having leaves of different shapes, some being broadly ovate, others resembling mittens, others being best described as "double-thumbed" mittens. In following out a young branch—this phenomenon is not so distinct on older trees—the first leaves are of simple outline, then the thumb is formed on the side of the leaf away from the branch, then follows a similar mitten, but the two are right and left-handed, then a pair of leaves with "thumbs" on both sides of the leaf, then a pair again right and left, with two fingers on the outer side and one on the inner side. Almost exactly the same arrangement may be seen on the sassafras. It seems that nature, setting out with a very simple plan, keeps improving upon it, always adding the variations on the side away from the branch, so that there results a succession of pairs of leaves, identical except for being right and left-handed. So far as I know, no other native tree has leaves of different pattern, save for the slight variations always seen in natural objects of any kind.

The study of the higher spirals is attended with considerable difficulty, the branches from which no leaves are missing being quite short, so that the leaves are apparently crowded into a fascicle, while older branches are apt to be deformed by accidents. It

is to be noted, also, that Nature seems to have followed in practice the theory by which we have explained her curious development of series. For example, a short willow branch seems to exemplify the $\frac{1}{3}$ phyllotaxy, but a longer stem plainly shows a $\frac{2}{5}$ arrangement. The plum and apple, similarly, are promoted by the careful student from the $\frac{2}{5}$ class to the $\frac{3}{8}$ class; and the walnut and butternut, which we are at first tempted to consider examples of the $\frac{3}{8}$ spiral, belong at least to the $\frac{5}{13}$ series, and the suspicion grows on us that, if we could find a perfect branch with a large number of leaves on it, we might ascend still higher in the range of spiral series. But it is of analytical value to be able to assign a plant to a place in one of two series, just as it is helpful to be able to say, "such a leaf has from five to seven pairs of leaflets."

The tulip tree, oaks, hickories, staghorn sumach and alternate leaved dogwood (the last two being arborescent) have the $\frac{2}{5}$ arrangement quite distinctly. In other instances the results were so conflicting, or the practical difficulties of obtaining good specimens were so great, that the summer closed before I could reach definite conclusions, if, indeed, it is possible to ascribe plants to certain series in all instances.

With the exception of the dogwoods, variations in phyllotaxy never cross generic lines and seldom if ever infringe upon the limits of families.

Reinke's Discussions of Lichenology.

By Albert Schneider.

It is thought advisable to give a review of Reinke's paper on lichenology, because this author is doubtless the most competent advocate of modern scientific lichenology. Although much of the author's discussion is based upon theory and the observations of others, yet the papers are of inestimable value to the special student, and we hope that they will be collected and issued in book form. Meanwhile it is hoped that this review may be found useful by those English-speaking students who can not readily avail themselves of the original communications.

I.

The Podetium of Cladonia.*

This paper is in reality a criticism of Krabbe's† monograph of the genus *Cladonia*. Krabbe maintains that the podetia belong to and are a part of the spore-bearing organs (apothecia). His conclusions are based upon the observation of the morphological characters and the mode of development which, according to Reinke and other modern biologists, are not sufficient. Nor can the morphological characters or structure be deduced from its development. Krabbe assumes that since the podetia of *Cladonia* originate in a manner similar to the apothecia of *Ramalina*, *Parmelia*, *Lecanora*, etc., they must be apothecial structures. The entire discussion depends upon the points of view. Krabbe, having considered the podetia from the morphological and developmental point of view, naturally comes to different conclusions from Reinke, who views the same structures from the physiological standpoint. It is an excellent example illustrating the necessity of combining morphology and physiology. Reinke very aptly states that if we allow morphology and development to dominate our investigations we may come to the absurd conclusion that the floral leaves are foliage-leaves and, *vice versa*, that the foliage-leaves are floral leaves. Extending the illustration we might conclude that mosses are liverworts, and that fungi are algae, etc. Reinke believes that the development of an organ should be represented as describing a curve which extends from the beginning to the point of maximum development of that organ. All intermediary stages of development are to be considered, but the special importance is to be attached to the fully developed structure. According to this view thallus, foliage-leaf, thorn, tendril, sepal, petal, stamen, pistil, should be represented as terminating at different points of the curve. With these and similar introductory considerations, the author finally enters upon the discussion of the podetia of *Cladonia*.

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* Reinke, J. Abhandlungen über Flechten. I. Das Podetium von *Cladonia*. Pringsheim's Jahrbücher, **26**: 495-523. 1894.

† Krabbe, G. Entwickelungsgeschichte und Morphologie der polymorphen Flechtengattung *Cladonia*. Ein Beitrag zur Kenntniss der Ascomyceten. Leipzig (A. Felix). 1891.

Reinke contents himself with de Bary's definition of the lichen-thallus; de Bary designates it as the vegetative organ bearing the apothecia, spermagonia, and in certain instances also pycnidia. This rather negative definition is accepted by most modern lichenologists who define the vegetative organ as the structure whose prime function is to take up and assimilate food-substances. Reinke also accepts, or at least expresses his disinclination to change, de Bary's definition of the reproductive organs; that is, the reproductive organs are the apothecia and spermagonia. If the experiments and observations of Stahl* and Sturgis† prove correct it would be more correct to speak of the *carpogone* and *spermagone* as the reproductive organs; but since it is highly probable that the spermagonia are merely parasitic fungi, or since their true nature is as yet problematical, we have no scientific authority to designate them as reproductive organs. This difference of opinion does not have any important bearing upon the question under consideration. It is, however, evident that Reinke considers the spermagonia as reproductive organs.

Reinke recognizes two portions of the *Cladonia*-thallus: the horizontal portion which is also called primary thallus or protothallus, and the vertical portion, or the podetium of lichenologists. The term thallus is quite generally applied to the horizontal or primary thallus, while the term podetium is retained to designate the vertical thallus. In all instances the podetium takes its origin from the gonidial (algal) zone of the horizontal thallus. Whether the beginnings of the podetium are due to a sexual act or not, is not definitely known. Krabbe and Reinke are inclined to believe that it is nonsexual. Reinke, however, hints at a *possible* sexual act represented by a fusion of the nuclei of two neighboring hyphal cells.

The primary axis of the podetium is negatively geotropic, thus differing essentially from the transversely geotropic dorsiventral horizontal structure of the primary thallus. If the podetia branch, it is found that the negative geotropism decreases with

* Stahl, E. Beiträge zur Entwickelungsgeschichte der Flechten, I. and II., Leipzig. 1877.

† Sturgis, W. C. On the Carpologic Structure and Development of the Collemaceae and Allied Groups. Proceedings of the American Acad. 25: 1890.

the number of branchings. In cross section the podetium is seen to have a radial structure, hollow, bearing a gonidial zone just within the outermost protective (cortical) covering. The assimilative surface of the podetium is usually much greater than that of the thallus-lobe, from which it took its origin. Both Krabbe and Schwendener * look upon the two distinctive forms of thallus as a species of alternation of generation. Wainio † believes that the apothecial stalk is converted into a vertical thallus by a form of metamorphosis. A similar view is held by Reinke; that is, the podetium was originally an apothecial stalk (perhaps comparable to that of the Caliciaceae and of *Bacomyces*) which finally became metamorphosed into a true thallus. This metamorphosis was of such a nature that the increase in size and assimilative function of the podetium corresponded to a decrease in size and function of the primary thallus.

The author enters into a more detailed discussion of the morphological characteristics of the leading types of *Cladonia* for the purpose of illustrating the structural modifications of the podetium and its relation to the primary thallus and apothecia. Life-size figures of the types accompany this discussion. Reinke quite frequently speaks of "fertile forms" when only "pycnidia" are present, which shows conclusively that he considers these structures as reproductive organs coequal in importance to the apothecia. The fact that the pycnidia (and spermagonia) may occur on either the primary thallus or the podetium, while the apothecia occur on the podetia (excepting a few *Cladonias* which are said to have no podetia or only pseudo-podetia) does not seem to raise any question in the author's mind as to the feasibility of considering the former as true sexual organs. This is only in passing, but it is well to remember that sexual organs are generally not so variable in their occurrence and position on the vegetative portion as the pycnidia and spermagonia evidently are.

Without going into further details the following summary may be given of Reinke's reasons for assuming that the podetium is a thallus rather than a reproductive organ.

* Schwendener, S. Untersuchungen über den Flechtenthallus. Nägeli's Beiträge zur Wissenschaftlichen Botanik, 2: 169. 1860.

† Wainio, Monographia Cladoniarum Universalis. Helsingfors, 1867.

1. A gonidial layer is present whose special function is that of assimilation. This is, however, not conclusive, since all apothecia with a thalloid exciple contain gonidia (algae), and therefore aid in the process of assimilation.

2. The extreme variability in the size and form of the podetium indicates that it belongs to the vegetative portion of the plant rather than the reproductive portion. Constancy in size and form is peculiar to the organs of reproduction.

3. The association of a large primary thallus with a small podetium and, *vice versa*, a small primary thallus (or none at all) with well developed, much-branched podetia seems to indicate that the podetium is specially adapted to supplant the function of the primary thallus.

4. Cladonias with highly developed podetia (*C. furcata*, *C. rangiferina*, etc.) are quite generally sterile (devoid of apothecia) and with primary thallus rudimentary or wanting. It would be absurd to consider such plants as reproductive organs since their prime function is vegetative.

Reinke admits that the podetia are phylogenetically derived from apothecia and thus in part agrees with Krabbe. The following are the main reasons for assuming that this is the case:

1. Podetia are developed endogenously from the gonidial zone of the primary thallus, similar to the apothecia.

2. Podetia have a radial structure similar to apothecia and apothecial stalks. This is in sharp contrast to the dorsiventral structure of the primary thallus.

3. The apothecia occur upon the podetia. An apparent exception is met with in *C. miniata* in which the apothecia seem to be sessile upon the upper surface or margin of the primary thallus. In this case the podetium has become much reduced, while the primary thallus has become much enlarged.

The general conclusion at which Reinke arrives is that *the podetium is a true lichen-thallus phylogenetically derived from the apothecium*.

II.

The Systematic Position of Lichens.*

This paper is a critical review of lichenology since the time of Schwendener's epoch-making investigations.† The author credits De Bary with first having indicated the dual nature of lichens by demonstrating that species of *Nostoc* and *Chroococcus* may be converted into gelatinous lichens upon becoming penetrated with the hyphae of certain parasitic Ascomycetes. It must be remembered that as late as 1863 Schwendener still believed that the gonidia (algae) were developed upon lateral and terminal branches of the hyphae.‡ De Bary made his discovery in 1865. In 1868§ Schwendener accepted this view and added that all lichens were the result of the union of an alga with some fungus. As the result of his investigations Schwendener concludes that lichens should no longer be considered as a distinct class, but as fungi parasitic upon algae (gonidia). He states: "In development the vegetative organs and the organs of reproduction of lichens are in all respects similar to those of *Ascomycetes*." Reinke has always agreed with Schwendener in the belief that the gonidia of lichens were true algae and the hyphae true fungi. Their opinions differed, however, as to the relationship of the two organisms. Reinke was not at all willing to look upon it as a form of ordinary parasitism. During the summer of 1872, in verbal communication with Griesebach, Reinke pointed out that the relationship indicated a mutual benefit. While the alga supplied the fungus with assimilated food-substances, the latter supplied the alga with water, nitrogen, phosphorus, sulphur and mineral salts. The relation of the fungus and alga in the lichen was comparable to the relation of the root and the leaves of a tree. In order to distinguish this form of relationship (symbiosis) from parasitism (antagonistic symbiosis) it was necessary to introduce a new term. Reinke and Grisebach

* Reinke, J. Die Stellung der Flechten im Pflanzensystem. Pringsheim's Jahrbücher, 26: 524–542. 1894.

† Schwendener, S. Die Algentypen der Flechten-gonidien. Basel, 1869.

‡ Schwendener, S. Nägeli's Beiträge zur Wissenschaftlichen Botanik, 3: 133–136. 1863.

§ Schwendener, S. Nägeli's Beiträge zur Wissenschaftlichen Botanik, 4: 195–202. 1868.

finally hit upon the word "consortism" as being especially appropriate. Reinke gives conclusive evidence that he has not been duly credited with first having pointed out the true conditions met with in the lichen thallus. This credit is given to de Bary, who is generally supposed to have been the first to point out and explain the phenomenon of "symbiosis" * as it occurs in lichens. The author had, however, previously explained this condition in three different publications.† From these it is evident that De Bary was not the discoverer of the phenomenon now known as mutualistic symbiosis, and that the term consortism antedates that of symbiosis. Reinke explains his views with regard to the lichen-thallus more fully as follows: "We have, therefore, in the thallus of lichens, a consortism, the components of which form a unit, a morphological individual, somewhat as the different tissues in a higher plant unite to form the individual. The fact that the alga can exist independently is dependent upon its ability to assimulate carbon. In the state of consortism, at least in the heteromerous thallus, the alga is nourished by the enclosing fungus; that is it receives from the hyphae the necessary minerals, nitrogen, oxygen, hydrogen and water. The alga in return supplies the fungus with the essential carbon compounds. From this it is evident that the components (alga and fungus) are biologically associated, mutually dependent upon each other, for the formation of the organic substances required for the upbuilding of the common body." The above is certainly conclusive evidence that Reinke had a correct view of the mutualistic relationship of alga and fungus in the lichen-thallus and furthermore that he was convinced that the lichen formed an autonomous structure.

The author expresses it as his opinion that the fungi of the higher Ascolichenes no longer exist independently, perhaps never so existed. The alga is, however, still able to lead an independent existence. It is also evident that there are free algae closely related, if not identical with the gonidia of lichens. This fact is of great importance in the consideration of the phylogenetic devel-

* De Bary, Die Erscheinung der Symbiose. Strassburg, 1879.

† Reinke, J. Göttinger Nachrichten. p. 100. 1872.

Reinke, J. Morphologische Abhandlungen. Leipzig, 1873.

Reinke and Grisebach, A. S. Oersted's System der Pilze, Lichenen und Algen. 1873.

opment of lichens. It is practically impossible to determine what free fungi are identical with the fungi of lichens. All investigators in this line have met with very unsatisfactory results, a thing naturally to be expected. According to Tavel* the fungi of the Collemaceae, Arthoniae and Lecideaceae are more or less closely related to the Patellariaceae. The relationship of the fungi of the Pertusariae, Lecanareae, Pannarieae, Umbilicarieae, Peltidiaceae, Parmeliaceae, Usneaceae, Cladoniaceae, Sphaerophoreae, Ephebeae and Lichineae is practically unknown. The Verrucarieae, Decampieae and Endocarpieae are related to the Amphisphaeriae, Sphaerelloideae. Such uncertainty is certainly very unsatisfactory

Although there may be algae, such as *Cystococcus humicola*, *Pleurococcus vulgaris*, *Nostoc lichenoides*, etc., which only await the opportunity to unite with some fungus to form a lichen, yet it is evident that no true Ascomycete has the power to enter into such a union. There is great uncertainty as to the exact method by which the first lichen or lichens were formed. The author makes the following hypothetical assumption: "In the beginning several lichens were formed by the union of true fungi with algae. According to Möller† such a process is now going on in the case of *Cora pavonia* and the related forms of *Dictyonema* and *Laudatea* The gelatinous lichens are very likely the oldest forms of the Ascolichenes. Such a gelatinous lichen took its origin as the result of the parasitic union of a fungus and a spherical colony of *Nostoc lichenoides*. The question of the origin of the fungus coincides with the question of the phylogenetic origin of parasitic fungi in general and need not be further discussed. The fungus which at first behaved like a true parasite (antagonistic symbiosis) took its entire food-supply from the nostoc. The condition of mutualism (consartism) was a phylogenetic product; perhaps due to natural selection or other formative causes resulting from the union of alga and fungus. From this proto-*Collema* other gelatinous lichens were evolved; finally also such with heteromerous thallus. It is probable that in the course of phylogenetic

* Tavèl, F. Vergleichende Morphologie der Pilze, pp. 94 and 108. Jena, 1892.

† Möller, A. Ueber die eine Thelephoree, welche die Hymenolichenen: *Cora Dictyonema* und *Laudatea* bildet. Flora 77: 254–278. 1893.

processes the developing spores of gelatinous lichens acquired the ability to enter into a mutually symbiotic union with other algae. A series phylogenetically derived from *Collema* may have taken an upward course, that is, proceeded from the lower to the higher, from the simpler to the more complex. As an example we may cite the natural series *Collema*, *Leptogium*, *Hydrothyria*, *Peltigera*. If *Stictina* is derived from *Peltigera*, *Sticta*, which is evidently *Stictina* with bright green algae, would also be included in the series. Every phylogenetically derived lichen-type constituted the beginning of a new series which may have proceeded upward or downward; that is in the direction of either higher or lower forms. In certain cases it is difficult to decide whether given lichens form the beginnings of a series or whether they are degenerate forms. Among such doubtful forms are included *Biatora uliginosa*, *Thelidium minutulum*, and species of *Buellia* and *Arthonia*. Many of these plants live parasitically upon other lichens, and no doubt bear a relation to these similar to the relation of *Cuscuta* and *Monotropa* to the chlorophyll-bearing genera of the same family. The above summary leads to the conclusion that there is a natural system of lichens distinct from that of fungi.

The author deplores the pernicious effect of Schwendener's plan of the arrangement of lichens. As a result lichens received only casual mention in an appendix to the different groups of lichens. Lichenologists (systematic) in general have strongly opposed Schwendener's plan of classification. Although Rèinke has always sympathized with these lichenologists, yet he regrets very much that they should have made their special attack upon Schwendener's theory of the dual nature of lichens.

The following is a brief summary of the leading items discussed in this paper:

1. The true relation of fungus and alga in the lichen-thallus was first pointed out by Reinke.

2. The term *Consortism* antedates the term *Symbiosis*.

3. Schwendener's (De Bary's) theory of the dual nature of lichens is fully accepted.

4. Most of the algal types occurring in lichens have been specifically determined. The fungal types no longer exist (at least in most cases) and can therefore not be determined.

5. A lichen is a phylogenetically derived morphological unit.

6. Lichens form groups of natural series phylogenetically derived from distinct prototypes. Lichens have, therefore a polyphyletic origin.

7. Lichens differ from the fungi morphologically as well as physiologically.

The following are the general conclusions at which Reinke arrives:

1. Although fully accepting Schwendener's theory, lichens are phylogenetically, morphologically and physiologically wholly distinct from fungi, and it is therefore inconsistent to arrange them under fungi.

2. Lichens form a natural group coequal in systematic importance with fungi and algae.

Since Reinke has written this paper Schwendener in a personal interview with E. L. Gregory * stated that he had no objection to the proposed plan of classification. Tubeuf, † as well as other recent authors, expresses the opinion that the lichen is an autonomous structure, a morphological unit. There are also strong objections, such as those cited by Lindau. ‡

A new Gymnogramme from Venezuela, with Remarks on some other Venezuelan Ferns.

By B. D. Gilbert.

Last spring Dr. H. H. Rusby, Secretary of this club, and Mr. R. W. Squires, of Minneapolis, made a botanical trip to Venezuela together and brought back with them a large collection of pressed plants, among which were about two dozen species of ferns. This fall Dr. Rusby placed the ferns in my hands for identification and it is found that although the collection is small it con-

* Gregory, E. L. Notes on the Classification of Lichens. Bull. Tor. Bot. Club. 23: 361. 1896.

† Tubeuf, K. F. Pflanzenkrankheiten. p. 102. Berlin. 1895.

‡ Lindau, G. Die Beziehung der Flechten zu den Pilzen. Hedwigia, 34: 195–204. 1895.

tains a number of choice things. Of course there are several common species which grow throughout the Antillean and South American tropics, such as *Polypodium Phyllitidis* and *P. Plumula*, *Dryopteris trifoliatum* and *D. macrophyllum*, *Nephrolepis acuta* and *N. exaltata*, *Asplenium serratum* and *A. cicutarium*. But along with these are others by no means so common, some of which are deserving of special mention.

The first of these in importance as well as interest is a new *Gymnogramme* belonging to the sub-genus *Selliguea*. Mr. Squires was particularly interested in collecting ferns and other cryptogams, and this species was gathered by him on the last day of the expedition, after all their other specimens were packed up. As Dr. Rusby says: "It was fired into a bale of paper on the fly, and dried itself. Two or three times afterward it was dropped aside and all but lost; and it seems quite remarkable that it should have survived for a description." Fortunately the specimens were finely fruited and complete in every respect; and they enable me to present herewith a full description of the plant.

GYMNOGRAMME (SELLIGUEA) HETEROPHLEBIA n. sp.

Rhizome wide-scandent, the younger part thickly clothed with long (¼ in.) lanceolate acuminate bright brown scales, the stipes springing directly from the rhizome, the older portion of rhizome bearing short branches on which the stipes are tufted.

Stipes single or two to three in a cluster from the same short branch of rhizome, when single ¾ to 1½ in. apart, ¼ to 1 in. long, clothed at base with same scales as rhizome.

Rachis distinct from base to tip stramineous naked. *Frond* 5–8 in. long, ⅞–1½ in. broad, lanceolate-ovate point generally acuminate, but sometimes round and blunt, surfaces naked, edge entire or slightly wavy, lower part of frond shortly narrowed into stipe; color light brown, texture membranaceous.

Veins of two kinds, primary ones raised, very distinct, running in wavy line from rachis two-thirds of way to edge. Also a finer series forming irregular areoles between the main veins with occasional free veinlets included, exterior veinlets free and clavate just within the edge.

Sori extending in two series from base to tip, one sorus in

each space between the primary veins situated half way between the rachis and edge oblique, one to three lines long, one line wide.

The affinity of this species is with *G. membranacea* HK., a native of the Malay and Philippine Islands. It differs from that species in having a short and straminеous stipe instead of one that is black and 2–6 in. long; also in the character of the veins, the primary veins not reaching the edge and the intermediate ones being much less distinct. Such a wide geographical separation as lies between the Philippines and South America need not of necessity be a bar to identity of species, since we have such examples as *Asplenium filix-foemina* and *Dryopteris mollis* that extend almost the world around. But these instances are quite rare; and in the genus *Gymnogramme* I am not aware of a single species that is common to both the eastern and western hemispheres.

This fern enjoys the distinction of being the only species, in the section of *Selliguea* to which it belongs, that is found in the western hemisphere. Out of 21 known species of *Selliguea*, including this, only 4 are natives of the new world, and of these only one occurs in any abundance. The fact that *Gymnogramme heterophlebia* has never been detected before is good evidence that it is a rare plant; for although new species of ferns are still discovered occasionally, South America has been pretty thoroughly ransacked and any fern that has hitherto escaped observation may be safely ranked among the rarities of that family.

This species happily illustrates the duplication of venation in different genera. If the sori were round instead of long the species would be a good example of the sub-genus *Phymatodes* in *Polypodium*, and would stand not far from *Phymatodes persicariaefolium* Schrad.

Another exceedingly interesting species in this collection is *Adiantum olivaceum* Baker. This belongs to the sub-genus *Hewardia*. In 1840 John Smith, of the Royal Botanical Gardens at Kew, then acknowledged to be one of the ablest pteridologists of his day, read a paper before the Linnaean Society and published a description in Hooker's Journal of Botany, in which he represented *Hewardia* as an entirely new genus from Guiana, which he dedicated to his friend Robert Heward, a Jamaica botanist of that pe-

riod. The pinnules of the original *Hewardia* are from 4 to 8 in. long, and are characterized by having a continuous involucre all around the edge. The involucre, however, is that of *Adiantum*, and when Sir Wm. Hooker came to publish his Species Filicum in 1858 he stated that he could "not see that it is agreeable to nature to separate a genus of ferns on account of the mere anastomosing of the veins of the pinnae." By that time another species of *Adiantum* with reticulated veins had been discovered on the Pacific side of tropical America, and Hooker only noted the two by putting them in a section by themselves. But ten years later, when the Synopsis Filicum was issued, he made a sub-genus of *Hewardia*, founded on the venation, and included two other species having long but interrupted sori. One of these was the fern now collected by Rusby and Squires, which was originally named by Mr. Baker. All of these four species belong to Guiana, although *A. olivaceum* has now been found in Venezuela, and *A. dolosum* occurs in Jumaica and on the continent from Guatemala to Brazil. The last named is the only one of the *Hewardiae* that can be regarded as at all common, while *A. olivaceum* is a rare and very desirable species.

There are specimens of three arborescent ferns in this collection, viz.: *Alsophila blechnoides* Hooker; *Hemitelia grandifolia* Spreng.; and *Hemitelia Guianensis* var. *Parkeri* Hook. In Hooker's Species Filicum he was inclined to regard *H. Parkeri* as distinct from *H. Guianensis;* but before publishing the Synopsis Filicum he had received a large suite of specimens from South America and became satisfied that the two supposed species were only slight varieties of one and the same thing. *H. Parkeri* is distinguished by its more abundant hairs and by a larger number of sori which extend farther up the segments. *Hemitelia grandifolia* is found in the West India islands as well as on the continent. The caudex of these species is so low that they can be called "arborescent" only by courtesy and because they belong to a genus the majority of whose species are truly arborescent.

Another curious fern in the collection is *Dryopteris meniscioides* (Willd.) Unlike any other species of the *Aspidium* section, its barren and fertile fronds differ in form, the fertile being contracted and made narrower by the excessive production of fruit. The entire under side of the pinnae is filled with the sori in regular lines, and

as the indusia are persistent after the sporangia have burst out all around the edges of them, it forms a very pretty and unusual sight. On the upper side of the pinnae the moon-shaped veins are quite plainly to be seen similar to the veins of the genus *Meniscum* and these give the fern its specific name. Neither Hooker's Species Filicum nor the Synopsis Filicum mentions the crowded state of the mature sori which gives this fern such a remarkable appearance; but Grisebach, in his Flora of the British West Indies, notes it as one of the characteristic features.

The genus *Antrophyum* contains 18 acknowledged species, of which only six, or just one-third, are inhabitants of the western hemisphere. The species of this genus present quite as good an example as those of *Acrostichum* of the changes that may be rung on a simple fronded fern without cutting of any kind to break it up into separate sections. The forms are created by differences in breadth and width, by long or short stipes, by blunt or acute apices, and by possessing or not a distinct midrib. Two species are distinctly characterized by the last-named feature. The commoner one is *Antrophyum Cayennense* Kaulf., which grows in Cuba as well as on the continent. The other *A. subsessile* Kze., is much less abundant, and this is the one which Dr. Rusby's collection contains. As its name implies, its fronds are almost, and sometimes quite sessile, whereas *A. Cayennense* has a stipe from 1 to 3 in. long. Another feature is that while the *veins* are reticulated as in all the species of this genus, the *sori* follow the oblique forkings of the veins, but seldom the reticulations. It is an interesting species for study. I might go on and speak of other attractive ferns in this collection, but the ones already mentioned are the most important and infrequent, while the others are liable to be found in almost any series coming from the American tropics. Enough has been said, however, to show that this collection contains more good things than would ordinarily be found in such a limited number of species.

The following is a complete list of the ferns of this collection:

Hemitelia grandifolia Spr. Rocky banks in deep forest along Eleanor Creek (110).

Hemitelia Guianensis Parkeri Hook. Rocky soil along creek, Manoa (384).

Alsophila blechnoides HK. Rocky banks in deep forest along Eleanor Creek (123).

Trichomanes pinnatum Swz., with unusually large pinnae (385).

Trichomanes membranaceum L. Completely covering the vertical faces, on the down-stream side, of large rocks among the cascades on Eleanor Creek and in deep shade (365).

Adiantum Kaulfussii Kze. Steep hillsides in heavy forests along Eleanor Creek (375).

Adiantum tetraphyllum Willd. With the last (374).

Adiantum (*Hewardia*) *olivaceum* Baker. With the last (376).

Pteris Kunzeana Agardh. With the last, but in dryer soil (373).

Asplenium serratum L. In rich mould about high ledges, in partially sunny places, along Eleanor Creek (372).

Asplenium cicutarium Swz. In rather dry locations on steep hillsides, in deep forest along Eleanor Creek (118).

Asplenium cuneatum Lam. On rocks in bed of stream in deep forest, Eleanor Creek (363).

Dryopteris meniscioides (Willd.) Kuntze. With the last (379).

Dryopteris trifoliata (L.) Kuntze With phenomenally small sori. Steep hillsides in deep forest, Eleanor Creek (383).

Nephrolepis exaltata Schott. Pendant from the axils of palm leaves, Sacupana (368).

Nephrolepis acuta Presl. On decaying logs in deep forest, Santa Catalina (386).

Polypodium piloselloides moniliforme Hook. Climbing shrubbery in partly cleared land, Santa Catalina (369).

Phegopteris tetragona megaloda (Schk). Forests about Santa Catalina (388).

Polypodium Phyllitidis L. Rich mould about high ledges, in sunny positions, Eleanor Creek (370).

Polypodium Plumula HBK. Pendant from axils of palm leaves, Santa Catalina (366). With unusually long fronds, more than 4 feet in length (367).

GYMMOGRAMME (SELLIGUEA) HETEROPHLEBIA n. sp. Climbing on tree-trunks, in deep forests about Santa Catalina (382).

Meniscium serratum Cav. On rocks in bed of stream, in deep shade, Eleanor Creek (378).

Acrostichum (*Gymnopteris*) *alienum* Swz. With the last (380).

Dryopteris propinqua (Br.). In the Synopsis Filicum this is made a variety of *N. unitum*, but it agrees with no *N. unitum* that I ever saw. Rocky banks of Eleanor Creek, in deep forest (128).

Dryopteris (*Sagenia*) *Martinicensis* (Spreng.) Kuntze. (*Aspidium macrophyllum* Baker.) Steep hillsides in deep forest, Eleanor Creek (381).

Antrophyum subsessile Kze. Dry hillsides about Menoa (371).

Nos. 364, 377, 380 and 401 are without fruit and not in a fit condition for determination.

Resemblance of an Insect Larva to a Lichen Fruit.

By G. E. Stone.

During the past summer while examining the bark of some sickly Camperdown Elms I observed a number of bodies about 1/8 inch in diameter, with a dark center and a drab lacerated foliaceous margin.

These bodies were considerably scattered over the trunk of the tree, they being confined largely, however, to the crevices caused by the irregularities of the bark. In taking a hasty glance at these bodies my first impression was that they were the apothecia of some lichen with which I was not familiar, although they had a marked resemblance in color, size and form to the apothecia of *Physcia hypoleuca*. In fact some of these bodies were attached to the thallus of species of *Physcia*, while others were simply attached to the bark, thus giving the appearance of a lichen fruit without a thallus. This feature impressed me as rather singular, as I had no previous recollection of seeing apothecia of this nature without a thallus. On closer examination, however, it could be seen that these bodies were not vegetable organisms, as piercing them with a sharp pointed stick soon revealed their animal characteristics. Indeed, so marked was the resemblance of these bodies to certain lichen fruit that it required some little observation before they could be discriminated.

On taking them to the College Insectary I soon learned that they were the larvae of an insect known to entomologists as the Imported Elm-leaf Beetle—*Gossyparia ulmi* Geoff—which has not been in Massachusetts but a few years.

The insect is common in Europe and attacks the European elms, but much less seldom our native *Ulmus Americana*. Whether there is any remarkable significance in the close resemblance of the insect larvae to the fruit of certain lichens common to the elm I am not able to say. The close resemblance nevertheless suggests mimicry.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Two Nuttallian Species of Oxalis.

By JOHN K. SMALL.

In the earlier part of this century Mr. Nuttall collected two species of *Oxalis* on the Pacific slope; the one he secured in Oregon, the other in California. The collector sent descriptions of his two new species to Torrey and Gray while they were publishing their Flora of North America. The descriptions were accompanied by specimens which are now preserved in the Herbarium of Columbia University.

Torrey and Gray reduced both the species to *Oxalis corniculata** and printed Mr. Nuttall's descriptions in a foot-note and thus the two plants for many years, and one to the present time, remained without further recognition.

The first of the two species described was *Oxalis pumila*.† It was said to occur in "Forests of the Rocky Mountains and Oregon." The original specimen I have to refer to is from Oregon, and consists of two plants, the one in flower the other in fruit. This form was later described by Professor Trelease as *Oxalis Suksdorfii*,‡ which name may stand on account of the earlier described *Oxalis pumila*,§ of D'Urville. The ample supply of *Oxalis Suksdorfii* which we now have from Oregon, agrees in all details with Mr. Nuttall's original specimens of *Oxalis pumila*. In addition to our material from Oregon, I find two specimens from California; they were collected many years ago and sent to Dr. Torrey. The

* Fl. N. A. 1: 212.

† T. and G. Fl. N. A. 1: 212.

‡ Mem. Bost. Soc. Nat. Hist. 4: 89.

§ Mem. Soc. Linn. Par. 4: 616. 1826.

record accompanying one is simply "California, Rev. A. Fitch,' while the other was collected by Dr. Parry when on the Mexican Boundary Survey, "between 32° and 36° N. Lat., and 114°–121° W. Long."

Professor Trelease referred with some doubt, both the original specimens of Mr. Nuttall and the later ones from California to his *Oxalis corniculata* var. (?) *macrantha*,* which position, in the light of recent material and our present knowledge of geographic distribution, cannot be maintained. The species is beautifully distinct, and in addition to other characters, the pod is diagnostic, as Mr. Nuttall intimates,† differing from that of all other relatives in its short conic form. As descriptions of the plant are not easy of access I append the following:

OXALIS SUKSDORFII Trelease, Mem. Bost. Soc. Nat. Hist. 4: 89. 1888.

Oxalis pumila Nutt.; T. & G. Fl. N. A. 1: 212, 183. Not D'Urv. 1826.

Perennial by a slender horizontal or creeping woody rootstock, caulescent, low and bushy or much elongated, somewhat pilose or sparingly villous. Stems ascending or decumbent, .5–4 dm. long, simple or nearly so; leaves palmately 3-foliolate, 2–3 cm. broad, usually glabrate except the ciliate edge; petioles slender, 3–8 cm. long; stipules obsolete, or a narrow dilation; leaflets broader than long, sharply notched, the lobes usually unequal, ciliate; peduncles usually surpassing the leaves; pedicels forming umbellate cymes, commonly 2, subtended by linear-subulate bracts; flowers usually bright yellow, about 2 cm. broad; sepals oblong or oblong-lanceolate, 4–5 mm. long, obtuse, villous, erect or ascending; petals obovate, 12–15 mm. long, undulate; filaments pilose; capsule conic, 8–11 mm. long, about twice as long as the sepals, usually pubescent; seed oval in outline, nearly 2.5 mm. long, its tubercles almost united into continuous transverse ridges.

Oregon and California.

The second species described by Mr. Nuttall in this connection, under the name *Oxalis pilosa* is just as worthy of specific rank as *Oxalis Suksdorfii*. It is apparently rarer; however the scarcity of it in our herbaria may be due to the fact that some collectors are inclined to pass by apparently well-known species in the field. The history of this species is shorter than that of *Oxalis*

* Mem. Bost. Soc. Nat. Hist. 4: 88.

† T. & G. Fl. N. A. 1: 212.

Suksdorfii; it begins with the original description* and ends with its union to *Oxalis corniculata* var. (?) *macrantha*,† as in the case of its sister species.

Mr. Nuttall collected his type in "Woods around St. Barbara, California," as is shown by his description and the label accompanying the type. The original specimen is sufficient to mark it as a very distinct species, and to support this I found an ample specimen preserved in the Torrey herbarium, which agrees with Nuttall's type in every particular. This second specimen consists of two plants which were collected in the "Valley of the Sacramento, California," by Dr. Stillman.

The gross characters which separate *Oxalis pilosa* from *Oxalis Suksdorfii* are habit, the densely pale pilose pubescence found on the stems, petioles, peduncles and pedicels, and the longer columnar pods. The species doubtlesss occurs in many herbaria. I give the following description:

OXALIS PILOSA Nutt.; T. & G. Fl. N. A. 1: 212. 1838.

Perennial by a woody base, caulescent, stoutish, densely pilose throughout, pale green. Stem erect, ascending, or decumbent, 1–3 dm. long, usually simple, woody below; leaves peltately 3-foliolate, 1–2 cm. broad, pilose on both sides; petioles slender, 2–6 cm. long, with narrow dilated stipules; leaflets mostly broader than long, sharply notched at the apex, ciliate, the lobes equal or nearly so; peduncles stoutish, surpassing the subtending leaves, topped by 1–3 umbellate-cymose pedicels which are subtended by linear-subulate bracts; flowers yellow, nearly 2 cm. broad, rarely solitary; sepals ovate-lanceolate or oblong-lanceolate, 4–5 mm. long, obtuse, pilose; petals obovate, notched, 12–15 mm. long; filaments pilose; capsule columnar, 1.4–1.7 cm. long, abruptly pointed, tipped by the spreading style-tips, clothed by a minute gray pubescence, commonly longer than the reflexed pedicels; seed obovoid, 1.5 mm. long, marked with slightly interrupted transverse ridges.

California, from the Valley of the Sacramento to Santa Barbara.

* T. & G. Fl. N. A. 1: 212.

† Mem. Bot. Soc. Nat. Hist. 4: 88.

Notes on New England Marine Algae—VII.

By Frank S. Collins.

(Plate ——.)

Lyngbya gracilis (Meneg.) Rab.; Gomont, Monographie des Oscillarieés, 144. *pl. 2, fig. 20.*

A small species, 5–8 μ in diameter, with slender sheath and cells usually shorter than broad; remarkable for the color, which is a purplish red, the living plant under the microscope reminding one of a very minute *Bangia.* I found it in July, 1896, at Cape Rosier, Maine, among other algæ on a mooring buoy that had been hauled up on the beach.

Spirulina versicolor Cohn; Gomont, Monographie des Oscillarieés, 273.

The trichomes are much like the common *S. subsalsa* Oersted, but the spiral is denser and more regular. The color is very distinct, a dark purple in the stratum, and a rosy purple in the trichome. In the dried specimen this color disappears almost entirely, giving place to the usual light green of the genus. Found at Cape Rosier, on the mooring buoy, with the *Lyngbya* mentioned above.

These two species just mentioned are, as far as I know, the only marine Nostochineae of a red color found in America; and it is somewhat interesting that both should have been found at the same time and place. The object on which they grew gives somewhat unusual conditions for the growth of algae; practically uniform depth combined with considerable movement of the water. It would hardly be safe to draw the conclusion that these conditions tended to produce the exceptional color, but it is of interest to note that the localities given by Gomont for both species are in the Mediterranean, Adriatic and Baltic, in all of which the tidal movement is quite small.

Enteromorpha minima Naeg. in Kuetz. Sp. Alg. 482.

A small species, somewhat resembling *E. micrococca* Kuetz., but with larger cells, 5–7 μ diam. In *E. micrococca* the cell-wall is much thickened, especially on the inside, while in the present

species there is no perceptible thickening, and the frond is only about 8–9 μ thick, as against 18 μ in *E. micrococca*. In consequence of this *E. minima* is softer and more flaccid than the other species. Found at half-tide mark, on the shore of Spectacle Island, Penobscot Bay, Maine, July, 1896.

ECTOCARPUS OVATUS Kjellman, Om Spetsbergens Thallophyter, Part 2, 35. *E. polycarpus* Kjellm. Skandinaviens Ectocarpeer och Tilopterideer, 93. *pl. 1. f. 5.*

A delicate species, characterized by the ovate plurilocular sporangia 28–52 μ long, 18–28 μ broad, sessile on the branches and opposite to each other or to a branch. Found at Edgartown, Mass., by Miss Colt, Feb., 1892.

SOROCARPUS UVAEFORMIS Pringsheim, Beiträge zur Morphologie der Meeresalgen, 12. *pl. 3. f. 1–8.*

Habit of *Ectocarpus*, differing in having the plurilocular sporangia in dense masses, usually at the bases of the branches. Found at Martha's Vineyard, Mass., by Miss Colt, in 1892.

PHYCOCELIS MACULANS n. sp.

Basal layer of radiating densely packed dichotomous somewhat irregular filaments, cells 12–14 μ diam.; vertical filaments simple, 14–16 μ diam., terminating in a colorless hair; plurilocular sporangia ovate-lanceolate, 50–60 x 18–25 μ, either terminal on few-celled filaments rising from the basal layer, or more commonly lateral on the longer erect filaments, and either sessile or on a one–several-celled pedicel.

In early stages the basal filaments are quite irregular in shape and branching, but when fully developed, form a regular circular disk, which, however, separates easily into fan-shaped segments. The erect filaments are long, straight, not tapering, with cells in the lower part one or two diameters in length; at the place of growth, in the upper part of the filament, the cells are quite short, and above this point they are much longer, and nearly or quite colorless. Short filaments bearing plurilocular sporangia may arise from any part of the basal layer; but more commonly sporangia are borne on the long erect filaments, and are either sessile or shortly pedicelled. One or several may be borne on a

filament; in the latter case they are usually secund, but sometimes alternate; they issue about at right angles to the filament, and are usually produced a short distance below the point of growth.

Found growing on *Rhodymenia palmata* Grev., in company with other epiphytic algae, in a warm shallow tidepool on Spectacle Island, Penobscot Bay, Maine, from July to September, 1894 to 1896. Distributed in Collins, Holden and Setchell, Phycotheca Boreali-Americana, No. 274.

PHYLLITIS ZOSTERIFOLIA Reinke, Algenflora der Westlichen Ostsee, 62.

Distinguished from the common *P. fascia* Kuetz. by the very narrow, strictly linear frond. *P. fascia* varies much in width, but even the narrowest forms broaden upward, and are proportionally much wider than those of this species, which may attain a length of 3 dm, with a width of hardly 5 mm. After one has recognized the plant there is no danger of mistaking for it any of the numerous forms of *P. fascia;* which moreover is essentially a winter and spring plant, while *P. zosterifolia* is a plant of the summer months. Collected at Magnolia, Mass., at extreme low-water mark, by Miss Cora H. Clarke, August, 1896. Distributed in Collins, Holden & Setchell, Phycotheca Boreali-Americana, no. 277.

LEPTONEMA FASCICULATUM Reinke, Atlas Deutscher Meeresalgen, 13, *pl. 31.*

The filaments resemble those of a small *Elachista*, and grow in similar tufts, branching only at the base, where are situated the ovate unilocular sporangia. The plurilocular sporangia, which form the principal characteristic of the genus, may be formed from any of the intercalary cells, but occur mostly in the upper part of the filament; the cell grows in a direction at right angles with the length of the filament, forming rather few-celled, usually pointed sporangia. Found at Spectacle Island, Penobscot Bay, Maine, September 2, 1894, growing on *Rhodymenia palmata* Grev., in a tide pool; a form corresponding to var. *majus* Reinke, l. c., the abundant sporangia occurring through the whole length of the nearly straight filament, and pointing in all directions.

DICTYOSIPHON HISPIDUS Kjellman, Algae of the Arctic Sea, 270.

Resembles a slender, much branched *D. foeniculaceus* Grev., and grows in similar places. Beside the ordinary branches of indefinite growth, the frond is beset with tapering branchlets, 2–4 mm. long; these cover the whole plant, except the base of the main stem and of the larger branches in old plants, from which they have apparently fallen off. The main stem is hollow, and the branches become hollow at an earlier stage of growth than in *D. foeniculaceus:* the sporangia are smaller than in the latter. Originally described as a form of *D. foeniculaceus*, it is now generally recognized as a good species. My specimens, collected at Nahant, Mass., in June, are of a darker brown in the dried state than European specimens, which are more of an olive color; otherwise they agree well.

ANTITHAMNION BOREALE (Gobi) Kjellman, Algae of the Arctic Sea, 180.

A few small plants growing on *Ptilota pectinata* Kjellm. were thrown upon the shore of Eagle Island, Penobscot Bay, Maine, after a storm in July, 1896. They seem to belong to forma *typica* of Kjellman, and agree quite well with a specimen from northern Norway, received from Foslie. This species might be mistaken for a small form of *A. Americanum* (Harv.) Farl., but the latter is proportionally more slender and has longer cells. *A. boreale* seldom exceeds 3 cm. in length; the ultimate branches are secund oftener than opposite. *A. Americanum* is a plant of early spring; *A. boreale* of late summer and autumn.

RHODOMELA VIRGATA Kjellman, Algae of the Arctic Sea, 110. *pl. 7.*

This species in its sterile state is hardly to be distinguished from *R. subfusca* Ag., the latter being, however, somewhat more densely and decompoundly branched. The distinction in fruit is strongly marked; in *R. subfusca* the tetraspores are formed in spring, in the slender terminal branches, which often become somewhat moniliform. In *R. virgata* they are found in winter, in short, densely branching ramuli, which issue without much order from the main stem and branches; cystocarps and antheridia occur in similar situations. Both these forms of fruit have long been

known, but both have been supposed to belong to *R. subfusca;* see Harvey, Nereis Boreali-Americana, Part 2, 26. The distinctions of the two species are shown in detail by Kjellman, l. c. Probably common, but to be distinguished with certainty only when fruiting, which occurs chiefly in December and January. Found at Revere Beach, Mass., by the writer; at Martha's Vineyard by Miss L. E. Jernegan.

POLYSIPHONIA VESTITA J. Ag. Algae Mediterraneae, 133; Species Algarum, 2: 987.

To this species I refer a plant from Martha's Vineyard, collected by Miss L. E. Jernegan. It is four-tubed, somewhat corticated below, with long patent branches, which are repeatedly branched and have a somewhat pyramidal outline. The whole plant is beset with short tufts of very fine and soft branching ramuli; in the older parts distant, in the younger closely set; color reddish purple. The specimen does not agree with any of the species credited to this coast, but is quite like the *P. vestita* of J. G. Agardh, as represented by a specimen from Hauck's herbarium; the *P. vestita* of Kuetzing is a different species.

Unless otherwise noted, all the species mentioned above were collected by the writer.

Explanation of Plate 278.

Phycocelis maculans Collins.

Fig. 1. Basal filaments at an early stage of growth. Fig. 2. Portion of fully developed basal disk. Fig. 3. Short, erect filament with terminal sporangium, and lower part of long erect filament, both arising from basal layer. Fig. 4. Upper portion of erect filament. Fig. 5. Portion of erect filament with two lateral sporangia, one of them emptied.

Reviews.

The Nursery Book. By Prof. L. H. Bailey. pp. 365. *figs. 152.* The Macmillan Company, New York. Price $1.00.

This is a very comprehensive, compact and lucid description of all the various modes of propagation of plants, not only belonging to the nursery proper, but takes in the denizens of the herbaceous garden, greenhouse, and all plants usually found on either commercial or private grounds; it is profusely illustrated, showing very minutely the best methods of seed testing, the sowing of

seeds, propagating by layering, budding, grafting and by cuttings. It gives very minute directions as to the treatment of all plants during their embryo state, in fact, all that can be learned about it except the actual practice. Some idea may be formed of the minute details gone into in this work when it is found that 180 pages are devoted to propagating alone. Altogether it is a very useful book to have handy either for the professional or amateur.

SAMUEL HENSHAW.

Proceedings of the Club.

WEDNESDAY EVENING, OCTOBER 28th, 1896.

Vice-President Allen occupied the chair and there were 29 persons present.

Mr. T. M. Fry, of 154 W. 98th street, and Mr. Laurence G. Goodhart, of 1148 Park avenue, were elected active members.

A paper by Mr. B. D. Gilbert, entitled "A New *Gymnogramme* from Venezuela, with Remarks on other Venezuelan Ferns," was presented by Prof. L. M. Underwood, the author not being present. The paper is published in this issue of the BULLETIN.

In discussing it, Prof. Underwood mentioned several ferns of the collection which grow also in Florida. Dr. Britton remarked on the heterogeneous elements which seem to be included in the genus *Gymnogramme*. In reply Prof. Underwood assented, and expressed the opinion that the new fern was really a *Polypodium*, although present artificial generic limitations required that it be assigned to *Gymnogramme*. Mrs. Britton remarked upon its resemblance to a Bolivian *Polypodium*. Dr. Rusby spoke of the great beauty of another fern of the collection, *Trichomanes membranaceum* L., as it covered the rocks in Eleanor Creek, where the specimens were collected.

For the author, Mr. J. H. Lovell, who was not present, Dr. Britton presented a communication on "Cleistogamy in *Dalibarda repens*." Discussing the paper, Dr. Britton referred to previous references in the BULLETIN on the same subject. Mr. Lovell also sent specimens illustrating polyphylly in the strawberry.

Dr. H. H. Rusby described a new genus from Bolivia, in the family *Icacinaceae*, illustrating it by specimens and black-board drawings. Its structural relations to the other groups of the family and to the associated genera were discussed. The communication was discussed by Dr. Britton. It will be published in the BULLETIN.

A communication from Miss S. B. D. Lewis on the species of *Nymphaea* found in Raquette Lake was presented by Dr. Allen. It was illustrated by colored drawings. The form of *Pontederia cordata* with cream-colored flowers was also reported by Miss Lewis. An animated discussion of the communication was participated in by Dr. Britton, Prof. Lloyd, Mr. Rydberg, Mrs. Britton and the Secretary.

Dr. Allen remarked on his collections and observations in the Far North, and exhibited a number of interesting specimens.

TUESDAY EVENING, NOVEMBER 10th, 1796.

The President in the chair and 27 persons present.

Miss S. B. D. Lewis was elected a corresponding member.

Miss Catharine Burnett read her announced paper entitled "The Influence of Light on the Morphology and Anatomy of Dorsiventral Organs," which will be published in a subsequent issue of the BULLETIN.

Dr. Emily L. Gregory remarked on her observation of numerous adventitious buds on the roots of the Horsechestnut tree (*AEsculus Hippocastanum*), when exposed to light by excavations for a street. An extended discussion of the occurrence of adventitious buds normally produced on the roots of other trees followed.

Prof. Francis E. Lloyd read a paper on "Some Interesting Forest Trees of Oregon," of which the following is an abstract:

The physical and climatic conditions of Oregon and Washington are such as to result in a large annual rainfall in the region west of the Cascade Mountains. This rainfall, while not excessive, is plentiful and nearly continuous for the greater part of the year. Further, a large body of snow is collected upon the Cascade Mountains; through the melting of this snow is furnished an abundant supply of water. The combined effect of a rich water supply and mild temperature is seen in the abundant vegetable

growth, and most strikingly in the forests. These are made up largely of conifers, a fair proportion of hardwoods being found in the valleys.

Among the trees described the most important are: *Pseudotsuga taxifolia*, *Thuya gigantea*, *Pinus Lambertiana*, *Pinus ponderosa*, *Picea Sitchensis*, and *Chamæcyparis Lawsoniana*, and of the hardwoods, *Quercus Garryana*, *Q. Californica* and *Acer macrophyllum*.

Their form and characters were briefly described and their economic value discussed.

Of more botanical than immediate economical interest are the alpine trees, of which there were described: *Pinus albicaulis*, *Tsuga Pattoniana* and *Abies lasiocarpa*. The influence of the winds at high elevations produces compact growth and spreading base in the latter two, while in the former extreme distortion obtains, together with low stature. These may be regarded as the forerunners of the future forests; it is their duty to subdue the rough mountain peaks.

The conditions for reforestation are of the best, and tree growth is rapid. The present methods of lumbering in the Pacific Northwest is extremely prodigal, and forestry methods should soon be insisted upon.

A number of photographs of trees were shown illustrating the discussion.

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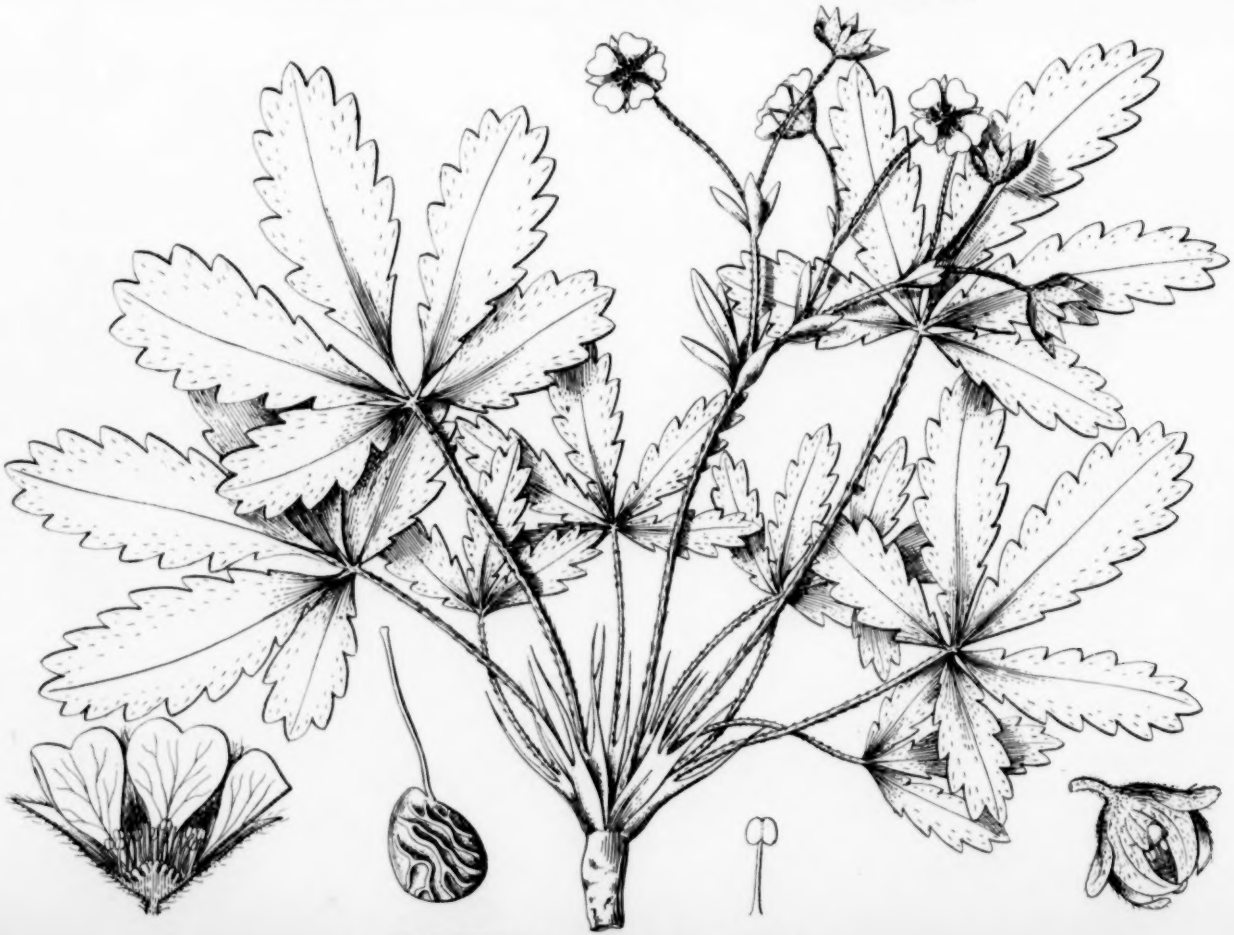
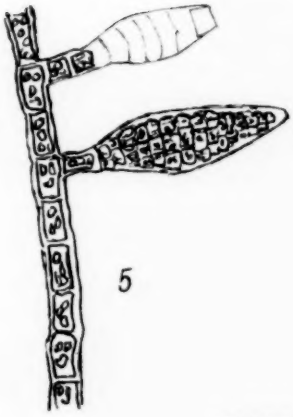


POTENTILLA RAMULOSA RYDBERG.

1–5. POTENTILLA MILLEFOLIA RYDB. 6–10. P. SAXIMONTANA RYDB.



PHYCOCELIS MACULANS COLLINS.

Contributions from the Herbarium of Columbia College.

[The numbers omitted from this list are out of print.]

VOLUME I.

No. 4. A List of Plants Collected by Miss Mary B. Croft at San Diego, Texas. By N. L. Britton and H. H. Rusby (1887), ... 25 cents.

No. 5. New or Noteworthy North American Phanerogams. By N. L. Britton (1888), ... 25 cents.

No. 6. An Enumeration of the Plants Collected by Dr. H. H. Rusby in South America, 1886–1887. By N. L. Britton. (Twenty-three parts published; not yet completed.)

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